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⑭無線送受信機

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明　細　書

1.発明の名称

無線送受信機

2.特許請求の範囲

送受信共用空中線を使用して微弱電波の送受信を行なう無線送受信機において、第1の端子に入力された信号はほぼ減衰なく第2の端子に出力され第3の端子に入力された信号は前記第1の端子に減衰されて出力されるが前記第2の端子にはほとんど出力されない方向性結合器を空中線結合回路として備え、該方向性結合器の前記第1の端子が前記送受信共用空中線に接続され、前記第2の端子が受信機入力端子に接続され且つ前記第3の端子が送信機出力端子に接続されていることを特徴とする無線送受信機。

3.発明の詳細な説明

本発明は同一の空中線を送受信で共用する無線送受信機に関し、特にその空中線結合回路の改良に関するものである。

一般に、送受信共用の空中線を使用した無線送受信機においては、空中線に誘起した受信信号電力が効率良く受信機に伝送されるように、受信時に空中線からみた送信機の入力インピーダンスが同じく空中線からみた受信機の入力インピーダンスより充分に大きくなる必要がある。このため、通常の単信方式の無線送受信機においては、例えば第1図に示すようにリレー等から成る空中線切換回路10を設け、受信時に空中線11と送信機12との接続を断つようにしている。しかし、このように空中線11に対する送信機12と受信機13の接続を空中線切換回路10を用いて切換える方式は、構成が複雑になるとともにリレー等の故障で信頼性が低下する欠点があるほか複信方式や半複信方式の無線送受信機には適用できず応用範囲も単信方式の送受信機に限定される。

そこで、例えば100m先での電界強度が15μV/m以下であるような微弱な電波を使用したトランシーバのように、送信機と空中線間の許容伝送損失を比較的大きくできる無線送受信機においては、例えば第2図に示すように空中線11と受信

機１３とは直結して直結合とし、空中線１１と送信機１２とはコンデンサ等のインピーダンス素子２０を介して粗結合とすることにより、空中線10に誘起した受信信号電力が低損失で受信機１３に伝送されるようにしたものが多い。このような構成に依れば、構造が簡易であり切換部を持たないので信頼性は向上するとともに単信方式，複信方式のどちらにも適用可能となる。しかしながら、空中線１１に印加された送信出力は直接受信機13にも分岐印加されるため、複信方式の無線送受信機においては送信信号により受信機１３の感度低下等を引き起こす欠点がある。このように第１図および第２図に示した方法には信頼性，簡便性，適用範囲や送信機から受信機への干渉等の点で問題があり、それぞれ一長一短があつた。

本発明はこのような従来の欠点を全て解消したものであり、リレー等の空中線切換回路を使用せずとも空中線に誘起した受信信号電力は極力損失少なく受信機に供給でき、且つ、送信出力の受信機へのまわり込みは極力防止できるようにすることを目的とする。以下実施例について詳細に説明する。

第３図は本発明の実施例を表わす要部ブロック図であり、第１図及び第２図と同一符号は同一部分を示し、３０は空中線結合回路を構成する方向性結合器、３１～３３はその第１，第２，第３の端子であり、これら端子間には次のような入出力関係が成立する。即ち、第１の端子３１に入力された信号はほぼそのままのレベルで第２の端子３２に出力され、第３の端子３３に入力された信号は第１の端子に減衰されて出力されるが第２の端子にはほとんど出力されない。このような構成の方向性結合器３０としては従来から各種のものが知られているので、本発明はそれらの任意のものを使用して構成する。例えば第３図に示すように、主伝送路３４と副伝送路３５とを結合させ、主伝送路３４の両端を第１及び第２の端子３１，３２に接続し、副伝送路３５の一端をダミーロード３６で終端し他端に第３の端子３３を接続する。

さて、本発明の無線送受信機は上述のような構成の方向性結合器３０を空中線結合回路として用い、その第１の端子３１に送受信共用の空中線11を接続し、第２の端子３２及び第３の端子３３に受信機１３の入力端子３７及び送信機１２の出力端子３８を接続したものである。従つて、空中線１１に誘起した受信信号電力は効率良く受信機13に伝送されるとともに、使用空中線１１の定在波比（SWR）が１であれば送信機出力の受信機１３へのまわり込みは実用上なくすことができる。たとえその定在波比が１から多少はずれていても、まわり込み量は従来回路に比較して著しく減少させることができ、一般に受信感度の低下は送信波のまわり込み量がある閾値以下であれば実用上皆無となるから、実質上受信感度の低下は防止される。

また、送信機１２の出力は例えば２０dB程度減衰されるが第１の端子３１を介して空中線１１に伝送されるので、あらかじめ送信機の出力をこの減衰分だけ大きく設定しておけば所定の電界強度で送信が行なわれることになる。前述したように、散乱電波使用の無線送受信機では、送信機１２と空中線１１間の許容伝送損失は比較的大きいので、本発明はそのような無線送受信機に適用すれば非常に有効となる。

なお、本発明は単信方式（プレストーク方式）のトランシーバにも適用可能であり、そうすればアンテナ切換スイッチ回路が不要となり、高信頼化および簡素化に役立つものとなる。

以上の説明から判るように、本発明は、空中線結合回路に方向性結合器を用い、空中線に誘起した受信信号電力は効率良く受信機に伝送し、一方受信機入力に対する送信出力のまわり込みは極力防止したものであり、複信方式の送受信機においては送信波のまわり込みによる受信機の感度低下等の障害を軽減し、単信方式の送受信機においてはリレー等の空中線切換回路を使用せずに送信機出力インピーダンスの並列効果による受信機の感度低下を軽減することが可能となり、送受信共用空中線を使用した無線送受信機の信頼性，性能等を向上させることができる。

4.図面の簡単な説明

第１図及び第２図は従来の無線送受信機の構成図、第３図は本発明の実施例を表わす要部ブロック図である。

１１は空中線、３０は方向性結合器、３１は第１の端子、３２は第２の端子、３３は第３の端子、３４は主伝送線、３５は副伝送線、３６はダミーロードである。

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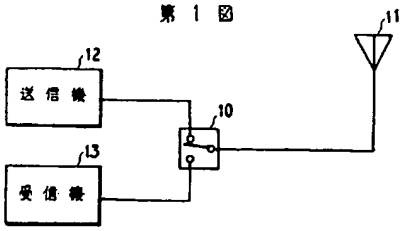
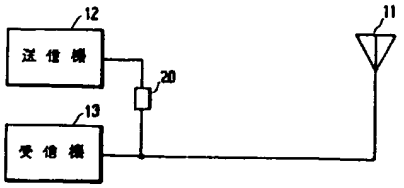
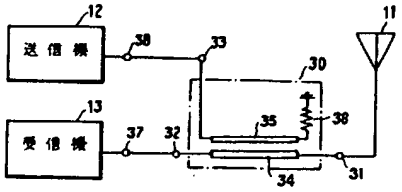
第１図



第２図



第３図



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(54) Radio Transceiver

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(74) Agent: Patent attorneys, Hisagoro Tamamushi, and three others

Specification

1. Title of Invention:
Radio Transceiver

2. What is claimed is:

A radio transceiver which transmits and receives weak radio waves using an antenna which is used for both transmission and reception, wherein the radio transceiver is equipped with, as an antenna coupling circuit, a directional coupler through which a signal inputted to a first terminal is outputted to a second terminal with almost no attenuation, and through which a signal inputted to a third terminal is attenuated and outputted to said first terminal while almost none of it is outputted to said second terminal, whereas said first terminal of the directional coupler is connected to said antenna which is used for both transmission and reception, said second terminal is connected to an input terminal of a receiver, and said third terminal is connected to an output terminal of a transmitter.

3. Detailed explanation of the invention

The present invention pertains to a radio transceiver which shares the same antenna for transmission and reception, and especially pertains to improvements in its antenna coupling circuit.

Generally, in a radio transceiver which employs an antenna used for both transmission and reception, in order for the electrical power of a reception signal induced on the antenna to be effectively transmitted to a receiver, the input impedance of a transmitter viewed by the antenna at the time of reception has to be sufficiently greater than that of the receiver viewed likewise by the antenna. For this reason, in a normal simplex radio transceiver, as shown in Figure 1 for example, an antenna switching circuit 10 made of a relay and so forth is provided to cut a connection between an antenna 11 and a transmitter 12 at the time of reception. Such a method in which the connection of the transmitter 12 to the antenna 11 and that of the receiver 13 to the antenna 11 are switched using the antenna switching circuit 10, however, has disadvantages in that the constitution becomes complex, and moreover, that the reliability decreases due to a failure in the relay and so forth. In addition, the method cannot be applied to duplex or semi-duplex radio transceivers, and the area of application is limited to simplex transceivers.

Therefore, for example, in a radio transceiver which can tolerate a relatively large transmission loss between a transmitter and an antenna such as one which uses a weak radio wave such as one with its electric field intensity of 1.5 micro V/m or below at a distance of 100 meters, in many cases, an antenna 11 and a receiver 13 are directly coupled to have a tight coupling, and the antenna 11 and a transmitter 12 have a loose coupling through an impedance element 20 such as a condenser as illustrated in Figure 2 as an example, so that the electrical power of a reception signal induced on the antenna 10 can be transmitted to the receiver 13 with a lower loss. With such a constitution, the structure becomes simple, and reliability improves because there is no switching section. In addition, such a method can be applied to both a simplex and duplex operation. A transmission output applied to the antenna 11, however, is diverted and directly applied to the receiver 13 as well, and therefore, in a duplex radio transceiver, the method has a disadvantage in that a transmission signal causes a decrease in sensitivity of the receiver 13. As described above, the methods shown in Figures 1 and 2 have problems in terms of reliability, ease and convenience of usage, an application range,

interference from a transmitter to a receiver and so forth, and hence, each method has its advantages and disadvantages.

The present invention resolves all of these disadvantages of conventional technologies. The object of the present invention is to enable the electrical power of a reception signal induced on an antenna to be supplied to a receiver with as small a loss as possible even without using an antenna switching circuit such as a relay, and to prevent, as much as possible, a transmission output from flowing into a receiver. Hereafter, an embodiment is explained in detail.

Figure 3 is the block diagram of main sections which describes the embodiment of the present invention. The same numerical codes indicate the same sections as those in Figures 1 and 2. The numerical code 30 represents a directional coupler which constitutes an antenna coupling circuit and the numerical codes 31 through 33 represent its first, second, and third terminal. Among these terminals, there is the following input and output relationship. In other words, a signal inputted to the first terminal 31 is outputted through the second terminal 32 at almost the same level, and a signal inputted to the third terminal 33 is attenuated and outputted through the first terminal, but is hardly outputted through the second terminal. Various types of conventional directional couplers are known as the directional coupler 30 having such a constitution and hence, the present invention is constituted using any of those couplers. For example, as shown in Figure 3, a primary transmission path 34 and a secondary transmission path 35 are coupled, and both ends of the primary transmission path 34 are connected to the first terminal 31 and the second terminal 32, respectively, while one end of the secondary transmission path 35 is terminated with a dummy load 36 and the other end is connected to the third terminal 33.

Furthermore, the radio transceiver of the present invention employs a directional coupler 30 with such a constitution as described above as an antenna coupling circuit, in which its first terminal 31 is connected to an antenna 11 which is used for both transmission and reception, and in which a second terminal 32 and a third terminal 33 are connected to an input terminal 37 of receiver 13 and an output terminal 38 of transmitter 12, respectively. Therefore, the electrical power of a reception signal induced on the antenna 11 can be efficiently transmitted to the receiver 13. In addition, if the standing wave ratio (SWR) of the antenna 11 which is being employed is 1, a flow of the output from the transmitter into the receiver 13 can be practically eliminated. Even when its standing wave ratio is slightly different from 1, the amount of flow

can be significantly reduced in comparison with conventional circuits. Generally, when the flow amount of transmitted waves to flow is equal to or below a certain threshold value, a decrease in sensitivity of a receiver becomes practically non-existent and therefore, a decrease in sensitivity of a receiver is practically prevented.

In addition, a transmission output from a transmitter 12 is attenuated by approximately 20dB, for instance. The output, however, is transmitted to an antenna 11 through a first terminal 31 and hence, if the output from the transmitter is set in advance at a value which is larger by the degree of attenuation, the transmission is performed with a given electric field intensity. As previously described, in a radio transceiver which employs weak radio waves, a tolerable degree of transmission loss between a transmitter 12 and an antenna 11 is relatively large and hence, the present invention is extremely effective when it is applied to such a radio transceiver.

Moreover, the present invention can also be applied to a simplex transceiver (a press-to-talk type) and in this case, an antenna switching circuit is no longer necessary, which contributes to improvements in reliability and simplification.

As is clear from the explanation above, in the present invention, a directional coupler is employed as an antenna coupling circuit. Thereby, the electric power of a reception signal induced on an antenna is effectively transmitted to a receiver, while a flow of a transmission output as an input to a receiver is prevented as much as possible. In a duplex transceiver, such disturbances as a decrease in sensitivity of a receiver caused by the flow of transmitted waves are eased. In a simplex transceiver, it is possible to reduce a decrease in sensitivity of a receiver caused by a parallel effect of the output impedance of a transmitter without using an antenna switching circuit such as a relay and so forth. Thus, the reliability and performance of a radio transceiver which employs an antenna for both transmission and reception can be improved.

4. Brief Explanation of Figures

Figures 1 and 2 depict structures of conventional radio transceivers, and Figure 3 is a block diagram of main sections which describes an embodiment of the present invention.

The numerical code 11 represents an antenna, the numerical code 30 represents a directional coupler, the numerical code 31 represents its first terminal, the numerical code 32 represents its second terminal, the numerical code 33 represents its third terminal, the numerical

code 34 represents a transmission path, the numerical code 35 represents a secondary transmission path, and the numerical code 36 represents a dummy load.

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Agent, Patent attorney: Hisagoro Tamamushi and three others

Figure 1

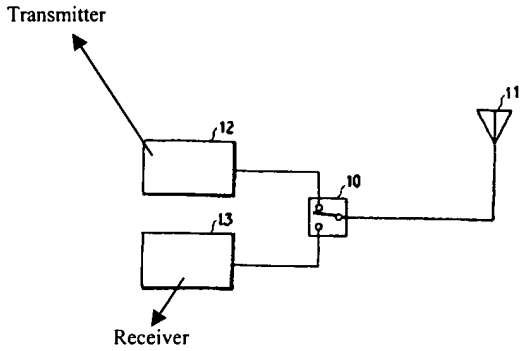

Figure 2

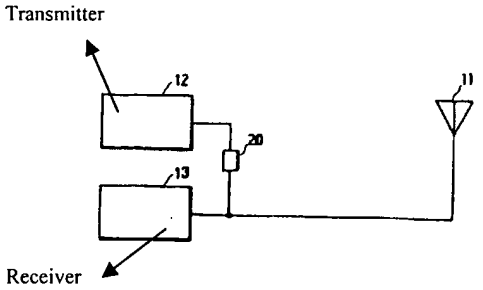

Figure 3